

What is claimed is:

- 1           1.     A system, comprising:  
2                 plural storage subsystems, each storage subsystem having a controller, an  
3     expander, and zero or more storage devices coupled to the expander, the controller to access  
4     storage devices through the expander, and the expander having interfaces for coupling to  
5     storage devices; and  
6                 an intercontroller link to connect expanders in different storage subsystems to  
7     enable the controller in one of the storage subsystems to communicate with the controller in  
8     another one of the storage subsystems through the expanders and the intercontroller link.
- 1           2.     The system of claim 1, wherein the controller, expander, and zero or more  
2     storage devices in each storage subsystem are coupled by a serial interconnect.
- 1           3.     The system of claim 1, wherein each of the storage subsystems have expanders  
2     at plural levels, the intercontroller link connecting expanders in the two storage subsystems at  
3     a first level, the system further comprising another intercontroller link to connect expanders  
4     in the two storage subsystems at a second level.
- 1           4.     The system of claim 1, wherein each storage subsystem includes serial  
2     attached small computer system interface (SAS) phys.
- 1           5.     The system of claim 4, wherein at least one of the expanders includes a SAS  
2     phy connected to the intercontroller link, wherein the at least one of the expanders includes a  
3     route table for the SAS phy, the route table containing a plurality of entries for routing  
4     information in the storage subsystem.
- 1           6.     The system of claim 5, wherein each of the expanders includes a route table  
2     for the SAS phy connected to the intercontroller link, and the route table is programmed  
3     differently than route tables for SAS phys not connected to the intercontroller link.
- 1           7.     The system of claim 4, wherein each of the expanders includes one or more  
2     SAS phys connected to the intercontroller link and one or more SAS phys connected to other

3 components of the storage subsystem, the system further comprising software to access the  
4 storage subsystem,  
5 wherein the one or more SAS phys connected to other components of the  
6 storage subsystem are visible to normal SAS discovery software but the one or more SAS  
7 phys connected to the intercontroller link are not visible to the SAS discovery software.

1 8. The system of claim 1, further comprising:  
2 plural computers comprising respective plural storage subsystems.

1 9. The system of claim 1, wherein each of the two storage subsystems has  
2 expanders at plural levels, the intercontroller link coupling expanders in the two storage  
3 subsystems.

1 10. The system of claim 1, wherein each of the two storage subsystems has  
2 expanders at plural levels, wherein each of the expanders is coupled to zero or more storage  
3 devices.

1 11. The system of claim 10, wherein at least some of the expanders are coupled to  
2 one or more storage devices.

1 12. The system of claim 11, wherein the controller in each of the two storage  
2 subsystems is adapted to access the storage devices through one or more expanders.

1 13. A method for use in a system having plural storage subsystems, each storage  
2 subsystem having a controller and an expander, the method comprising:  
3 accessing, by the controller in a first one of the storage subsystems, a storage  
4 device in the first storage subsystem through the expander in the first storage subsystem; and  
5 communicating over an intercontroller link that connects the expander in the  
6 first storage subsystem with an expander in a second one of the storage subsystems, wherein  
7 the controller in the first storage subsystem communicates with the controller in the second  
8 storage subsystem through the intercontroller link and the expanders in the first and second  
9 storage subsystems.

1           14.    The method of claim 13, wherein each of the expanders in the first and second  
2 storage subsystems includes a SAS phy connected to the intercontroller link, the method  
3 further comprising:  
4                providing a routing table for the SAS phy in each of the first and second  
5 storage subsystems; and  
6                populating a plurality of entries in the routing table with routing information.

1           15.    The method of claim 13, wherein each of the expanders in the first and second  
2 storage subsystems includes one or more SAS phys connected to the intercontroller link and  
3 one or more SAS phys connected to other components of the storage subsystem, the method  
4 further comprising:  
5                enabling the one or more SAS phys connected to other components of the  
6 storage subsystems to be visible to normal SAS discovery software;  
7                maintaining the one or more SAS phys connected to the intercontroller link not  
8 visible to the SAS discovery software.

1           16.    The method of claim 13, further comprising accessing, by the controller in the  
2 second storage subsystem, a storage device in the second storage subsystem through the  
3 expander in the second storage subsystem.

1           17.    The method of claim 13, further comprising the controllers in the first and  
2 second storage subsystems communicating with each other over the intercontroller link to  
3 maintain cache coherency.

1           18.    An expander in a first storage subsystem, comprising:  
2                a first interface to couple to a storage device;  
3                a second interface to couple to an intercontroller link to connect the expander  
4 in the first storage subsystem with an expander in a second storage subsystem; and  
5                a controller to communicate with another controller in the second storage  
6 subsystem through the second interface and the intercontroller link.

1           19.    The expander of claim 18, wherein each of the first and second interfaces  
2 comprises one or more SAS phys.

1           20.    The expander of claim 19, further comprising a storage to store a route table  
2 associated with each SAS phy to couple to the intercontroller link, the route table containing  
3 routing information associated with the second storage subsystem.

1           21.    The expander of claim 20, further comprising an additional SAS phy to couple  
2 to another expander in the first storage subsystem, the storage further to store a route table  
3 associated with the additional SAS phy, wherein the route table for the SAS phy to couple to  
4 the intercontroller link is programmed differently than the route table for the additional SAS  
5 phy.

1           22.    A system comprising:  
2                   plural storage subsystems, each storage subsystem having a means for  
3 controlling access to storage devices, and expanding means for coupling to the storage  
4 devices; and  
5                   means for interconnecting the expanding means in different storage  
6 subsystems to enable the controlling means in one of the storage subsystems to communicate  
7 with the controlling means in another one of the storage subsystems through the expanding  
8 means and the interconnecting means.

1           23.    The system of claim 22, wherein each of the expanding means has a SAS phy  
2 to connect to the interconnecting means.